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E-SYSTEMS
Montek Division

Report No. 131500-621
19 August 1977

ELECTROMAGNETIC COMPATIBILITY TEST REPORT FOR THE AN/TRN-41 TACAN NAVIGATIONAL SET

Prepared for:
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AN/TRN-41 TACAN Navigational Set

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report describes the electromagnetic compatibility tests on the Navigatinnal Set, TACAN, AN/TRN-41 as described in the Electromagnetic Compatibility Test Plan for the Navigational Set, TACAN, AN/TRN-41 Revision A, dated 12 November 1976.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

for the

NAVIGATIONAL SET, TACAN, AN/TRN-41

This report describes the electromagnetic compatibility tests on the Navigational Set, TACAN, AN/TRN-41 as described in the Electromagnetic Compatibility Test Plan for the Navigational Set, TACAN, AN/TRN-41 Revision A, dated 12 November 1976.

1. Test Identification. The electromagnetic compatibility tests are as outlined in the Electromagnetic Compatibility Test Plan and meet the requirements of paragraph 3.3.2 of Specification No. 404L-701-5017A, Part I of two parts, Prime Item Development Specification for Navigational Set, TACAN, AN/TRN-41.

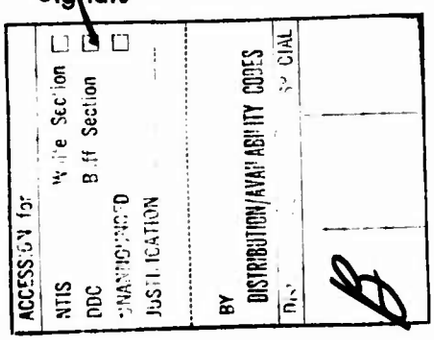
2. Functional Purpose. These tests form a part of the AN/TRN-41 qualification tests.

3. Test Objectives. To demonstrate that the AN/TRN-41 will meet the CS-03 intermodulation, CS-04 rejection of undesired signals, CS-05 cross modulation, RE-02 electric field emission and RS-03 electric field susceptibility requirements of MIL-STD-461 as specified in Specification No. 404L-701-5017A.

4. Description of Test Article. The receiver-transmitter RT-1202/T of the AN/TRN-41 was tested for the CS-03, CS-04 and CS-05 tests. The AN/TRN-41 system was tested for the RE-02 and RS-03 tests.

5. Summary of Test Results. Following is a summary list of test results for the five electromagnetic compatibility tests conducted:

CS-03 Intermodulation	No intermodulation frequencies observed.
CS-04 Rejection of Undesired Signals	One spurious frequency was measured at 889.3 MHz with the system set to channel 1X. This signal was rejected by 75 dB which is greater than the specification requirements of 65 dB.



CS-05 Cross Modulation	No cross modulation products observed.
RE-02	Some areas out of specification, see paragraphs 9 and 11.
RS-03	By agreement with ESD the field strength was changed from 200 V/M to 100 V/M. Some areas were out of specification, see paragraphs 9 and 11.

6. Description of Test Facility and Procedures. The test facilities and test procedures are described in the Electromagnetic Compatibility Test Plan.

7. Test Setup Diagrams. The test setup diagrams are provided in the Electromagnetic Compatibility Test Plan.

8. List of Test Equipment. The following is a list of test equipment used, with manufacturer and model number and with calibration date at time of test if applicable. The list is divided in three parts; that used for conducted susceptibility tests, that used for radiated emissions tests and that used for radiated susceptibility tests.

TEST EQUIPMENT FOR CONDUCTED SUSCEPTIBILITY TESTS

Name	Mfg. and P/N	Calibration Date
RF Signal Generator	HP 608E	7/77
RF Signal Generator	HP 612A	6/77
RF Signal Generator	HP 612A	6/77
RF Signal Generator	HP 8614A	6/77
RF Signal Generator	HP 8616A	6/77
RF Signal Generator	HP 618C	6/77
RF Signal Generator	HP 620B	6/77
Oscilloscope	Tektronix 465	7/77
Pulse Generator	Datapulse 110B	8/77
Counter	Fluke 1953A	4/77
Transfer Oscillator	HP 540	8/77
Power Divider	Engleman D200M	N/A
Directional Coupler, 20 dB	Narda 3042B-20	N/A

Name	Mfg. and P/N	Calibration Date
Directional Coupler, 20 dB	HP 776D	N/A
Half Amplitude Detector	Montek 131500-702	N/A
Low Pass Filter	HP 360A	N/A

TEST EQUIPMENT FOR RADIATED EMISSIONS TESTS

Name	Mfg. and P/N	Calibration Date
EMI Receiver	Singer NM7	5/77
EMI Receiver	Singer NM 17/27	5/77
EMI Receiver	Singer NM 17/37	5/77
Spectrum Analyzer	AIL Tech 707	9/77
Antenna	Singer 93490-2	N/A
Antenna	Singer 94455-1	N/A
Antenna	Singer VA105A	N/A

TEST EQUIPMENT FOR RADIATED SUSCEPTIBILITY TESTS

Name	Mfg. and P/N	Calibration Date
RF Signal Generator	HP 612A	11/77
Pulse Generator	Data Pulse 1108	6/77
Linear Detector	Montek 135203-100	N/A
Oscilloscope	Tektronix 585	10/77
Directional Coupler	Narda 3042B-20	N/A
Directional Coupler	HP 776D	N/A
RF Signal Generator	HP 606	11/77
RF Signal Generator	HP 608D	11/77
RF Signal Generator	AIL Tech 125	3/78
TWT Microwave Amplifier	Servo Corporation	N/A
Power Amplifier	IFI 406L	N/A
RF Voltmeter	IFI EFS-1/LMT	9/77

9. Recorded Test Data. Following is a list of attachments containing recorded data.

Attachment 1 — Data Sheet for Conducted Susceptibility Tests CS-03, CS-04 and CS-05

Attachment 2	Graphs of Radiated Emissions Tests
Attachment 3	Data Sheets for Radiated Susceptibility Tests
Attachment 4	Pre Operational Test Data Sheet
Attachment 5	Changes considered and implemented

10. Ambient Conditions. The Electromagnetic Compatibility Tests were performed at ambient room temperature conditions.

11. Test Results Analysis. Following is an analysis of the test results for each test method used:

Intermodulation Products

The receiver-transmitter RT1202/T was tested for intermodulation products using method CS-03 of MIL-STD-462 as described in the electromagnetic compatibility test plan. No intermodulation products were observed. See Attachment 1.

Rejection of Undesired Signals

The receiver-transmitter RT 1202/T was tested for rejection of undesired signals using Method CS-04 of MIL-STD-462 as described in the electromagnetic compatibility test plan. One undesired response was observed at 899.3 MHz but was rejected by 75 dB. This is within specifications. See Attachment 1.

Cross Modulation

The receiver-transmitter RT1202/T was tested for cross modulation using method CS-05 of MIL-STD-462 as described in the electromagnetic compatibility test plan. No cross modulation frequencies were observed. See Attachment 1.

Radiated Emissions

First measurements of emissions showed very bad out-of-tolerance measurements in both narrow band and broadband in the ranges of 14 kHz to 1 MHz and from 6 MHz to 30 MHz. From 30 MHz to 300 MHz some areas were out-of-tolerance. Above 300 MHz, no out-of-tolerance readings were seen. The bad readings from 14 KHz to 1 MHz were

found to be caused by interaction between the transmitted signal and the circuitry in the receiving antenna for the test equipment. A passive antenna was substituted and the readings in this range were then in tolerance.

To correct the problems above 6 MHz the changes in Attachment 5 were tested and implemented as indicated.

After the indicated changes were made, the readings shown in Attachment 2 were obtained. Narrowband and broadband scans were made on channels 65X and 123X and with the system in standby.

Out of tolerance readings were as follows:

	Broadband		Narrowband	
	Frequency	dB/μV Out of Tolerance	Frequency	dB/μV Out of Tolerance
Channel 65X	43 MHz	5	13.5 to 14.5 MHz	5
	290 MHz	8	31 MHz	6
			43 MHz	12
Channel 123X	123 MHz	5	13.5 to 14.5 MHz	5
	130 MHz	5	Spike at 14.3 MHz	10
	137 MHz	8	43 MHz	10
			Spike at 189 MHz caused by test equipment not on previous scan at 189 MHz.	

In an attempt to isolate the source of the out-of-tolerance readings, tests were run with the system operating in the DME mode. In this mode, all readings in both narrowband and broadband tests were within tolerance. This indicates that the out-of-tolerance emissions are originating in the antenna (DC motor-speed control circuitry and/or trigger generating circuitry).

All reasonable methods have been used to reduce the emissions from these sources, therefore, E-Systems requests that the AN/TRN-41 system be accepted as is with the few out-of-tolerance areas as described above.

Radiated Susceptibility

During the first scans of the electric field at 200 V/M, it was found that at some frequencies the system circuit breaker would trip and at other frequencies the replies to interrogations would be affected. These failures were in the field frequency range of 15 MHz to 200 MHz.

The specification for the electric field strength in this test was reduced to 100 V/M by agreement with the Air Force. Using this field strength some frequencies were still affected until changes were made as described in Attachment 5. After these changes were made, the system was tested and the results are shown in Attachment 3.

The following out-of-tolerance readings were observed during the final test:

	Frequency of failure	Failure level V/meter
Channel 65X	63 MHz	75 V/M
	360 MHz	77 V/M
	560 MHz	55 V/M
	610 MHz	45 V/M
Channel 123X	63 MHz	70 V/M
	230 MHz	50 V/M
	265 MHz	50 V/M
	340 MHz	55 V/M
	450 MHz	55 V/M
	570 MHz	50 V/M

In all of the above cases, the failure mode was the loss of detected reply pulses.

E-Systems is not aware of any situation where the AN/TRN-41 system will be subjected to electric field strength even close to the magnitude of those where failures occurred. Therefore, it is requested that the AN/TRN-41 system be accepted as is with these out-of-tolerance readings as described above.

This test was found to be very difficult and hazardous to control and perform due to the very high field strengths required.

It should be noted also that the latest revision to MIL-STD-461A (6 March 1973) reduces the field strength to 1 volt/meter over the frequency range of 14 KHz to 10 GHz.

ATTACHMENT 1

DATA SHEET FOR CONDUCTED SUSCEPTIBILITY TESTS,

CS-03, CS-04 AND CS-05

DATA SHEET
FOR
CONDUCTED SUSCEPTIBILITY TESTS

Date 8 March 77 Serial No. 002

			Reading	Check if OK
1.1.2	Standard Reference Output			
	b.	Pulse width (3.5 ± 0.5 μs)	3.5 μs	
		Pulse pair spacing (12.0 ± 0.5 μs)	12.0 μs	
		Interrogation rate (200 ± 2 pulses/second)	200 pps	
	c.	Frequency f_0 (~~1088~~ 1025 MHz ± 20 kHz)	1025 MHz	
	h.	Standard reference output level	.80 V	
1.1.3	Signal Generator Set Up			
	f.	Pulse width (3.5 ± 0.5 μs)	3.5 μs	
		Pulse pair spacing (12.0 ± 0.5 μs)	12.0 μs	
		Interrogation rate (200 ± 2 pps)	200 pps	
	g.1	SIG GEN NO. 1 frequency (1025 MHz ± 20 kHz)	1025 MHz	
		SIG GEN NO. 2 frequency (1025 MHz ±20 kHz)	1025 MHz	
	g.2	SIG GEN NO. 1 attenuator	-80 dB	
		SIG GEN NO. 2 attenuator	-56 dB	
	g.3	SIG GEN NO. 1 frequency (1150 MHz ± 20 kHz)	1150 MHz	
		SIG GEN NO. 2 frequency (1150 MHz ± 20 kHz)	1150 MHz	
		SIG GEN NO. 1 attenuator	78 dB	
		SIG GEN NO. 2 attenuator	-61 dB	
1.1.4	Intermodulation, Method CS-03			
	a.	SIG GEN NO. 1 attenuator	-124 dB	
		66 dB above 1.1.3.g.2		
	F_0 = 1025 MHz			
	b.	Frequency f_1	1052.3 MHz	
	c.	$\Delta f = f_1 - f_0$	27.3 MHz	
	d.	SIG GEN NO. 2 frequency ($f_1 + \Delta f$)	1079.6 MHz	
	e.	SIG GEN NO. 2 attenuator	-113 dB	
		66 dB above step g.		
	h.	Intermodulation frequency	MHz	
		Intermodulation rejection	dB	
		Intermodulation frequency	MHz	
		Intermodulation rejection	dB	

1.1.4.h (continued)		Reading	Check if OK
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
i.	Frequency F_2	1002 MHz	
j.	$\Delta f_2 = f_0 - f_2$	23 MHz	
k.	SIG GEN NO. 2 frequency $f_2 - \Delta f_2$	979 MHz	
m.	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
n.	Repeat steps a through m.		
o.	SIG GEN NO. 1 attenuator	-12 dB	
	66 dB above 1.1.3.g.3.		____
	f_0 = 1150 MHz		
b.	Frequency f_1	1182.3 MHz	
c.	$\Delta f = f_1 - f_0$	31.3 MHz	
d.	SIG GEN NO. 2 frequency ($f_1 + \Delta f$)	1213.6 MHz	
e.	SIG GEN NO. 2 attenuator	+5 dB	
	66 dB above 1.1.3.g.3		____
h.	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	

1.1.4.n (continued)		Reading	Check if OK
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
l.	Frequency F_2	1137.9 MHz	
j.	$\Delta f_2 = f_0 - f_2$	12.1 MHz	
k.	SIG GEN NO. 2 frequency $f_2 - \Delta f_2$	1125.8 MHz	
m.	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	
	Intermodulation frequency	____ MHz	
	Intermodulation rejection	____ dB	

1.1.5 Rejection of Undesired Signals, Method CS-04.

b.	SIG GEN NO. 2 frequency	1062.6 MHz
e.	Spurious frequency	____ MHz
	Rejection	____ dB
	Spurious frequency	____ MHz
	Rejection	____ dB
g.	Spurious frequency	____ MHz
	Rejection	____ dB
	Spurious frequency	____ MHz
	Rejection	____ dB
l.	SIG GEN NO. 2 frequency	991.0 MHz
k.	Spurious frequency	999.3 MHz
	Rejection	-75 dB
	Spurious frequency	____ MHz
	Rejection	____ dB

1.1.5 (continued)

		Reading	Check if OK
l.	SIG GEN NO. 2 frequency	1183 MHz	
m.	Spurious frequency	MHz	
	Rejection	dB	
	Spurious frequency	MHz	
	Rejection	dB	
n.	SIG GEN NO. 2 frequency	1118.7 MHz	
p.	Spurious frequency	MHz	
	Rejection	dB	
	Spurious frequency	MHz	
	Rejection	dB	
r.	Spurious frequency	MHz	
	Rejection	dB	
	Spurious frequency	MHz	
	Rejection	dB	

1.1.6 Cross Modulation, Method CS-05

c.	frequency f_1	MHz	
g.	Cross modulation frequency	MHz	
	Timing shift	nSec	
	Cross modulation rejection	dB	
	Cross modulation frequency	MHz	
	Timing shift	nSec	
	Cross modulation rejection	dB	
	Cross modulation frequency	MHz	
	Timing shift	nSec	
	Cross modulation rejection	dB	
l.	Frequency f_2	MHz	

6. Page B-11, 1.1.2.c, change frequency from 1088 MHz to 1025 MHz.

7. Add to 1.1.2 of data sheet the following

i. Frequency f_0 (1150 MHz ± 20 KHz) 1150.01 MHz

Standard Reference Output Level .80 V

8. Replace paragraph 1.1.6 of the data sheets pages B-14 and B-15 with the following:

1.1.6 Cross-Modulation, CS-05

a. Attenuator of SIG GEN NO. 2 +1 dB

c. Frequency of SIG GEN NO. 2 1052 MHz

d. Frequency of SIG GEN NO. 1 1025 MHz (1025 MHz ± 20 KHz)
SIG GEN NO. 1 Atten Setting -70 dB

e. Cross-Modulation Frequency _____ MHz
SIG GEN NO. 2 Atten Setting _____ dB
Cross-Modulation Rejection _____ dB

Cross-Modulation Frequency _____ MHz
SIG GEN NO. 2 Atten Setting _____ dB
Cross-Modulation Rejection _____ dB

Cross-Modulation Frequency _____ MHz
SIG GEN NO. 2 Atten Setting _____ dB
Cross-Modulation Rejection _____ dB

f. Attenuation of SIG GEN NO. 2 (step a) +1 dB

Frequency of SIG GEN NO. 2 (step c) 1001 MHz

g. Cross-Modulation Frequency _____ MHz
SIG GEN NO. 2 Atten Setting _____ dB
Cross-Modulation Rejection _____ dB

Cross-Modulation Frequency _____ MHz
SIG GEN NO. 2 Atten Setting _____ dB
Cross-Modulation Rejection _____ dB

Cross-Modulation Frequency _____ MHz
SIG GEN NO. 2 Atten Setting _____ dB
Cross-Modulation Rejection _____ dB

h. Attenuation of SIG GEN NO. 2 (step a) +1 dB

Frequency of SIG GEN NO. 2 (step c) 1176 MHz

Frequency of SIG GEN NO. 1 1150 MHz (1150 MHz ± 20 KHz)

SIG GEN NO. 1 Atten Setting -#68 dB

(step e)

Cross-Modulation Frequency	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation Frequency	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation Frequency	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB

(step f)

Attenuation of SIG GEN NO. 2 (step a)	+1	dB
Frequency of SIG GEN NO. 2 (step c)	1129	MHz

(step g)

Cross-Modulation	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB

ATTACHMENT 2

GRAPHS OF RADIATED EMMISSIONS TESTS

The charts on pages 21 through 26 of this attachment are the recordings of the broadband and narrowband emissions from the AN/TRN-41. Pages 17 through 20 are charts that list the correction factors required to determine the radiated emissions limits for the charts. These charts use the broadband and narrowband specification limits of Figures 21 and 22 of MIL-STD-461A and then add in the relaxation of Notice 3 and the antenna factor. Bandwidth compensation and antenna orientation is also corrected for if required.

Broadband emissions were taken with 0 dB attenuation in the line so the corrected specification limit is shown on the broadband charts as a line.

Narrowband emissions were taken with -20 dB in line so the readings would be high enough on the chart to be readable. Therefore, 20 dB was added to the corrected limits of pages 17 through 20 for the limit line on the narrowband charts.

CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3

41" ROD ANTENNA

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3		BROADBAND			NARROWBAND	
				Specification Limit MIL-STD-461A Fig. 22	Bandwidth Compensa. 50 kHz to 1 MHz	Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
.014		+10		100.0	-26		35	
.05		+10		94.0	-26		32.5	
.10		+10		91.0	-26		31.5	
.15	-35.5	+10		89.0	-26	37.5	30.5	5.0
.20	-36.2	+10		87.0	-26	34.8	30	3.8
.25	-36.7	+10		86.0	-26	33.3	29.5	2.8
.30	-38.0	+10		85.5	-26	31.5	29	1.0
.35	-38.5	+10		85.0	-26	30.5	28.5	0.0
.40	-32.0	+10		84.0	-26	36.0	28.5	6.5
.45	-32.8	+10		83.5	-26	34.7	28.0	5.2
.50	-33.5	+10		83.0	-26	33.5	28.0	4.5
.60	-34.5	+10		82.0	-26	31.5	27.5	3.0
.70	-35.5	+10		81.5	-26	30.0	27.0	1.5
.80	-36.0	+10		81.0	-26	29.0	27.0	1.0
.90	-27.1	+10		80.0	-26	36.9	26.5	9.4
1.0	-27.5	+10		79.5	-26	36.0	26.5	9.0
1.2	-28.0	+10		79.0	-26	35.0	26.5	8.5
1.4	-29.0	+10		78.0	-26	33.0	26.0	7.0
1.6	-29.5	+10		77.5	-26	32.0	25.5	6.0
1.8	-30.5	+10		77.0	-26	30.5	25.5	5.0
2.0	-30.8	+10		76.5	-26	29.7	25.0	4.2
2.5	-24.5	+10		75.5	-26	35.0	24.5	10
3.0	-24.2	+10		74.5	-26	34.3	24.5	10.3
3.5	-24.6	+10		74.0	-26	33.4	24.0	9.4
4.0	-25.0	+10		73.0	-26	32.0	24.0	9.0
4.5	-25.0	+10		72.5	-26	31.5	23.5	8.5
5.0	-25.3	+10		72.0	-26	30.7	23.5	8.2
5.5	-21.6	+10		72.0	-26	34.4	23.0	11.4
6.0	-21.0	+10		71.5	-26	34.5	23.0	12.0
6.5	-20.7	+10		71.0	-26	34.3	23.0	12.3
7.0	-20.5	+10		70.5	-26	34.0	22.5	12.0

CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3

41" ROD ANTENNA (Contd)

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3		BROADBAND			NARROWBAND	
				Specification Limit MIL-STD-461A Fig. 22	Bandwidth Compensa. 50 kHz to 1 MHz	Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
7.5	-20.0	+10		70.0	-26	34.0	22.5	12.5
8.0	-20.0	+10		70.0	-26	34.0	22.5	12.5
9.0	-20.0	+10		69.5	-26	33.5	22.0	12.0
10.0	-20.0	+10		69.0	-26	33.0	22.0	12.0
11.0	-20.0	+10		68.5	-26	32.5	22.0	12.0
12.0	-20.0	+10		68.0	-26	32.0	21.5	11.5
13.0	-19.0	+10		68.0	-26	33.0	21.5	12.5
14.0	-19.0	+10		67.0	-26	32.0	21.0	12.0
15.0	-19.2	+10		67.0	-26	31.8	21.0	11.8
16.0	-19.3	+10		67.0	-26	31.7	21.0	11.7
18.0	-19.5	+10		66.5	-26	31.0	20.5	11.0
20.0	-19.5	+10		66.0	-26	30.5	20.5	11.0
22.0	-20.2	+10		65.5	-26	29.3	20.5	10.3
24.0	-20.7	+10		65.0	-26	28.3	20.0	9.3
26.0	-21.0	+10		65.0	-26	28.0	20.0	9.0
28.0	-21.5	+10		64.0	-26	26.5	20.5	9.0
30.0	-22.0	+10		64.0	-26	26.0	21.0	9.0

CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3

BICONICAL ANTENNA

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3	45° Antenna Orientation Correction	BROADBAND			NARROWBAND	
				Specification Limit MIL-STD-461A Fig. 22		Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
30	-12.5	+10	-3	64		58.5	21	15.5
40	-14.0	+10	-3	62.5		55.0	23	16.0
50	-11.5	+10	-3	61		56.5	25	20.5
57	- 9.0	+10	-3	61		59.0	25	23.0
55	-10.0	+10	-3	61		58.0	25	22.0
60	- 8.0	+10	-3	60		59.0	26	25.0
70	- 6.75	+10	-3	60		60.25	27	27.25
80	- 9.25	+10	-3	59		56.75	28	25.75
90	-11.25	+10	-3	58.5		54.25	29	24.75
100	-12.5	+10	-3	58		52.5	30	24.5
105	-12.5	+10	-3	58		52.0	30	24.5
101	-12.5	+10	-3	58		52.0	30	24.5
110	-12.5	+10	-3	57.5		52.5	30	24.5
120	-13.0	+10	-3	57		51.0	31	25.0
130	-15.0	+10	-3	57		49.0	31	23.0
140	-17.5	+10	-3	56.5		46.0	31	20.5
150	-18.5	+10	-3	56		44.5	32	20.5
160	-18.0	+10	-3	56		45.0	32	21.0
170	-17.0	+10	-3	55.5		45.5	32	22.0
180	-15.0	+10	-3	55.5		47.5	33	25.0
190	-13.0	+10	-3	55		49.0	33	27.0

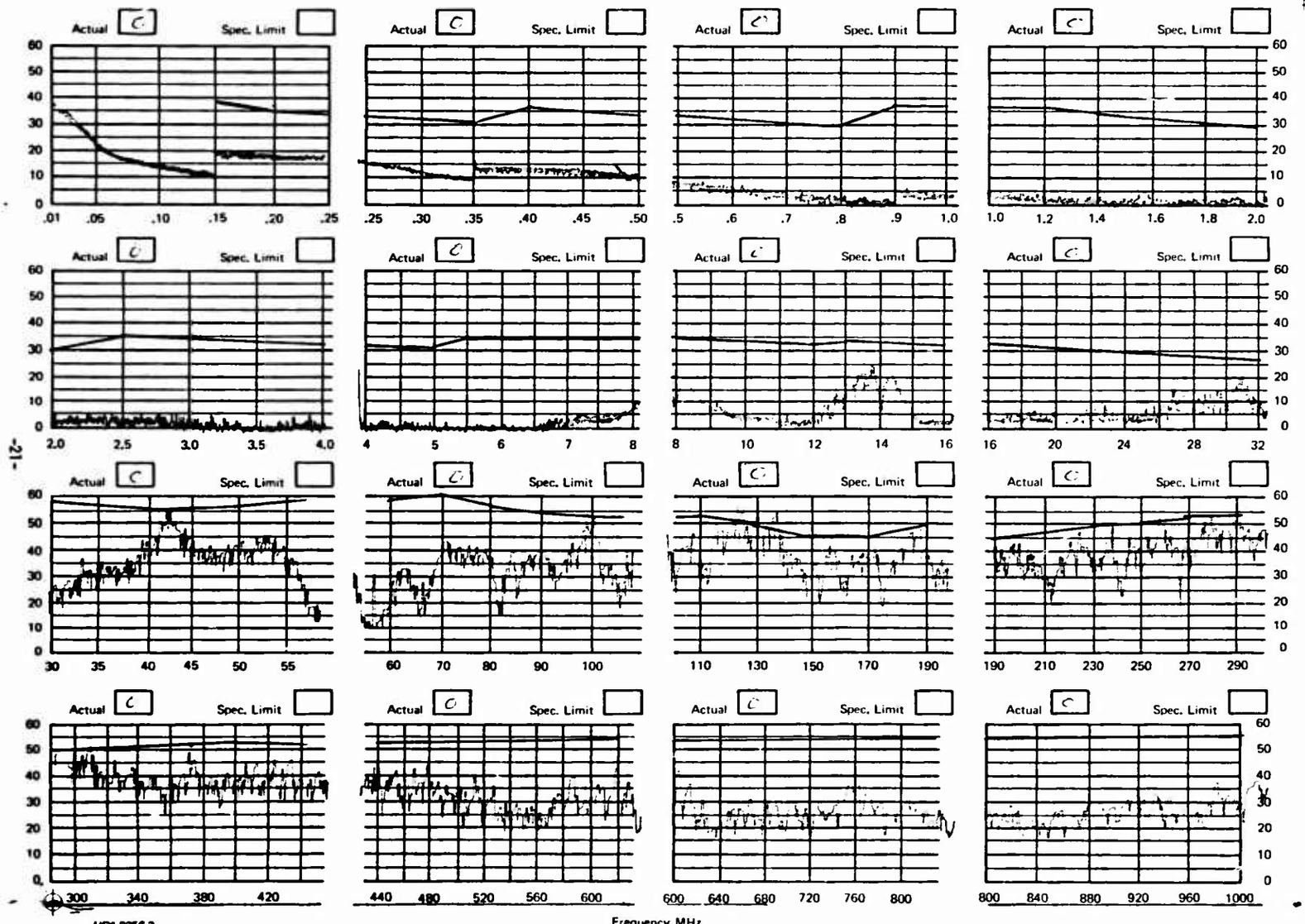
CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3

CONICAL LOG SPIRAL ANTENNA

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3		BROADBAND			NARROWBAND	
				Specification Limit MIL-STD-461A, Fig. 22		Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specificati Limit
190	-21	10		55		44	33	22
210	-20	10		56		46	34	24
230	-18.5	10		56.5		48	34.5	26
250	-17.5	10		57		49.5	35	27.5
270	-17	10		57.5		50.5	35.5	28.5
290	-17	10		58		51	36	29
300	-17	10		59		52	37	30
320	-17	10		59		52	37.5	30.5
340	-17.5	10		59.5		52	38	30.5
360	-17.5	10		60		52	38.5	31
380	-18	10		60.5		52.5	39	31
400	-18.5	10		61		52.5	39	30.5
420	-19	10		61.5		52.5	39.5	30.5
440	-19.5	10		62		52.5	39.5	30
480	-20	10		63		53	40	30
520	-20.5	10		63.5		53	40	29.5
560	-21	10		64		53	40.5	29.5
600	-21.5	10		65		53.5	41	29.5
640	-22	10		66		54	41	29
680	-22.5	10		66.5		54	41.5	29
720	-23	10		67		54	42	29
760	-23	10		67.5		54.5	42.5	29.5
800	-24	10		68		54	43	29
840	-24	10		68		54	43.5	29.5
880	-24.5	10		68.5		54	44	29.5
920	-25	10		69		54	44	29
960	-25.5	10		69.5		54	44.5	29
1000	-26	10		70		54	45	29

UNIVAC

ATTENUATOR SETTINGS



UDI 9256-2

Date MAY 2 0 1977 Page No. 1

A.O. _____

Customer _____

Test Sample _____

Part No. AN/ARN-41

Serial No. 001

Specification [illegible]

Notice _____

Test Method _____

- ☐ Conducted
- ☐ Radiated
- ☐ Broadband
- ☐ Narrowband
- ☐ Transient

Test Mode _____

Test Equipment

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- ☐ Current Probe – PC105 S/N H-301
- ☐ LISN – 7010
- ☐ 10μf–Capacitor
- ☐ Antenna Loop
- ☐ Antenna Rod 41" – 95010-1 S/N 169
- ☐ Antenna Biconical 94455-1 S/N 47
- ☐ Antenna Conical 93490-1 S/N 109

Bandwidth _____

Scan Speed _____

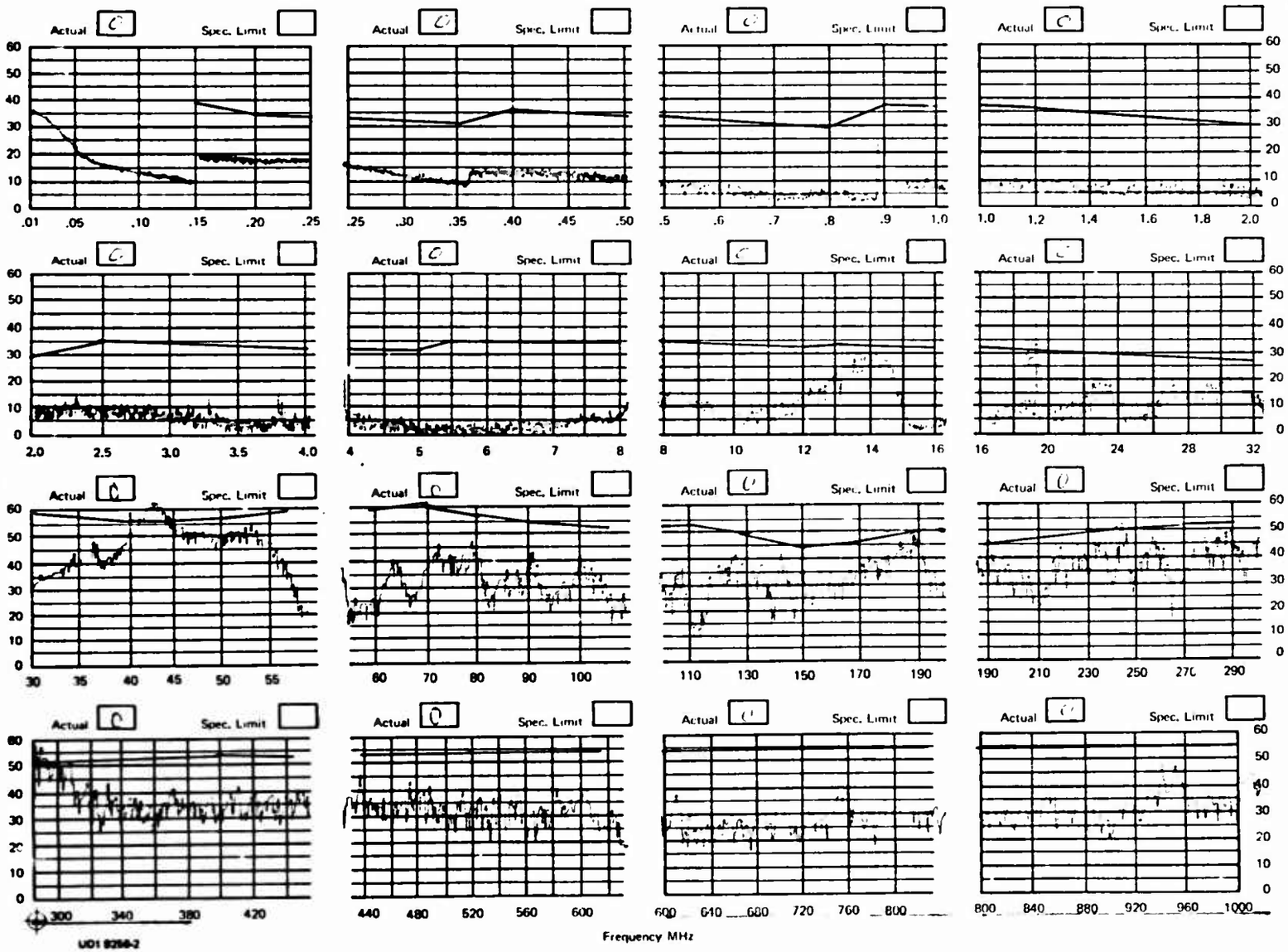
Remarks 123X

Conducted by _____

Witnessed by _____

UNIVAC

ATTENUATOR SETTINGS



UDI 82568-2

Date MAY 1977 Page No. -2-

A.O.

Customer

Test Sample

Part No. AN/TRN-41

Serial No. 001

Specification MIL-STD-461

Notice

Test Method

- ☐ Conducted
- ☐ Radiated
- ☐ Broadband
- ☐ Narrowband
- ☐ Transient

Test Mode

Test Equipment

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- ☐ Current Probe – PC105 S/N H 301
- ☐ LISN – 7010
- ☐ 10μf–Capacitor
- ☐ Antenna Loop
- ☐ Antenna Rod 41" – 95010-1 S/N 169
- ☐ Antenna Biconical 94455-1 S/N 47
- ☐ Antenna Conical 93490-1 S/N 109

Bandwidth

Scan Speed

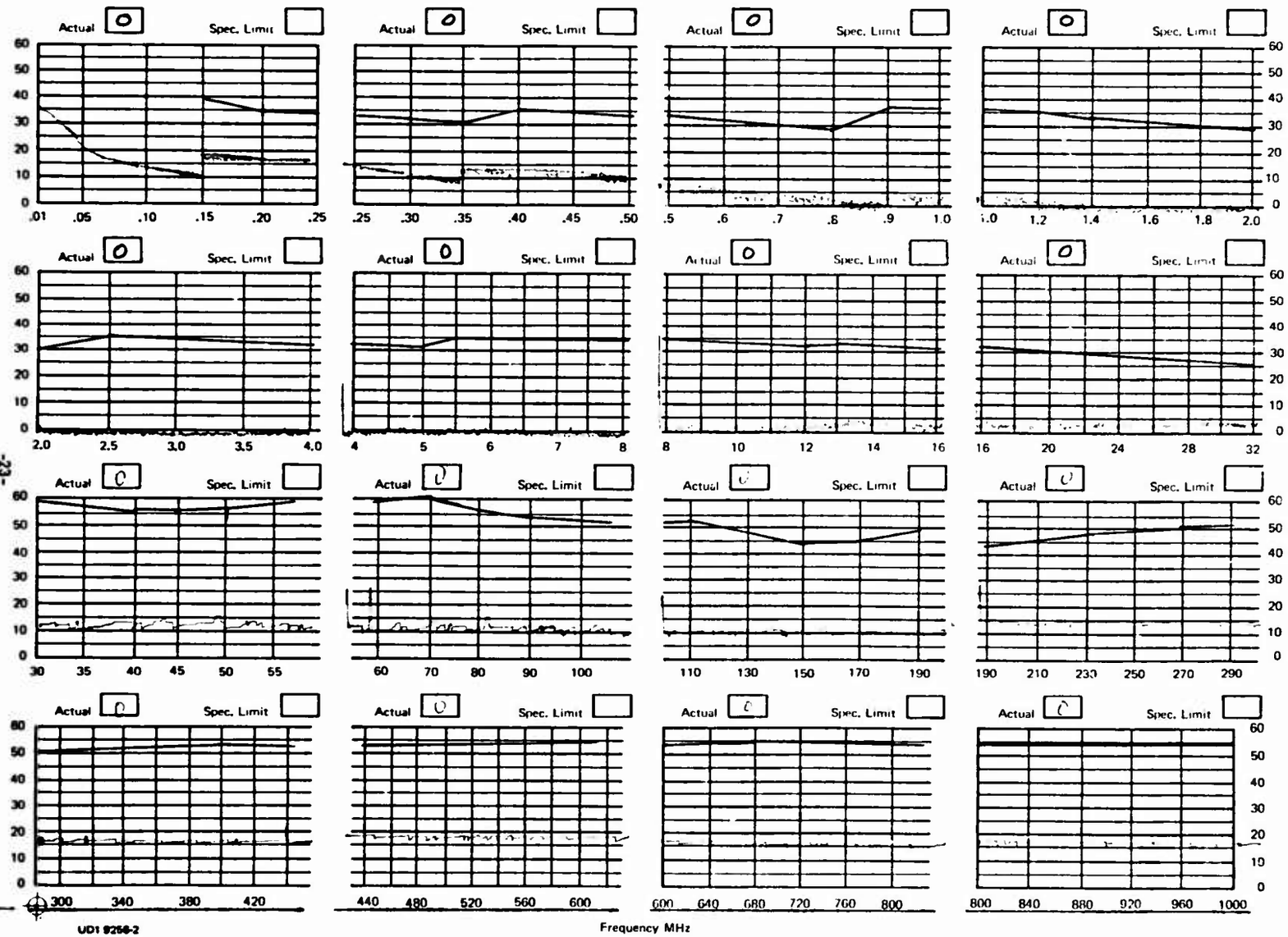
Remarks 65X

Conducted by

Witnessed by

UNIVAC

ATTENUATOR SETTINGS



UD1 9256-2

Date MAY 2 6 1977 Page No. 3

A.O.

Customer

Test Sample

Part No. AN/TRN-41

Serial No. 001

Specification [illegible] 461

Notice

Test Method

- ☐ Conducted
- ☐ Radiated
- ☐ Broadband
- ☐ Narrowband
- ☐ Transient

Test Mode

Test Equipment

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- ☐ Current Probe – PC105 S/N H-301
- ☐ LISN – 7010
- ☐ 10μf – Capacitor
- ☐ Antenna Loop
- ☐ Antenna Rod 41" – 95010-1 S/N 169
- ☐ Antenna Biconical 94455-1 S/N 47
- ☐ Antenna Conical 93490-1 S/N 109

Bandwidth

Scan Speed

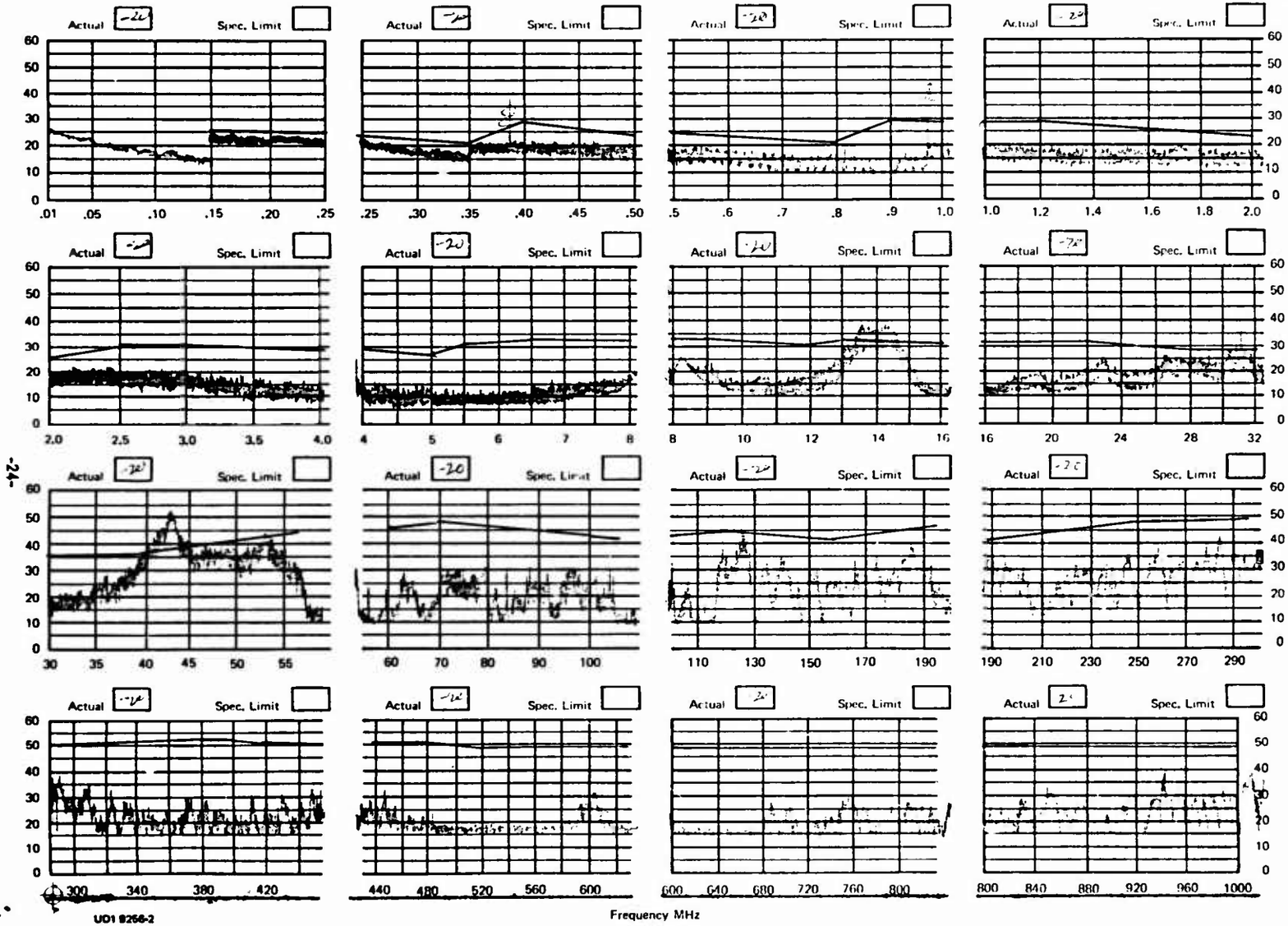
Remarks Standby

Conducted by

Witnessed by

UNIVAC

ATTENUATOR SETTINGS



UD1 9266-2

Frequency MHz

-24-

Date [illegible] Page No. 4

A.O.

Customer

Test Sample

Part No. AN/TRN-41

Serial No. 001

Specification [illegible]

Notice

Test Method

- [ ] Conducted
- [x] Radiated
- [ ] Broadband
- [x] Narrowband
- [ ] Transient

Test Mode

Test Equipment

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- [ ] Current Probe – PC105 S/N H-301
- [ ] LISN – 7010
- [ ] 10μf – Capacitor
- [ ] Antenna Loop
- [ ] Antenna Rod 41" – ~~95010-1 S/N 169~~
- [x] Antenna Biconical 94455-1 S/N 47
- [x] Antenna Conical 93490-1 S/N 109

Bandwidth

Scan Speed

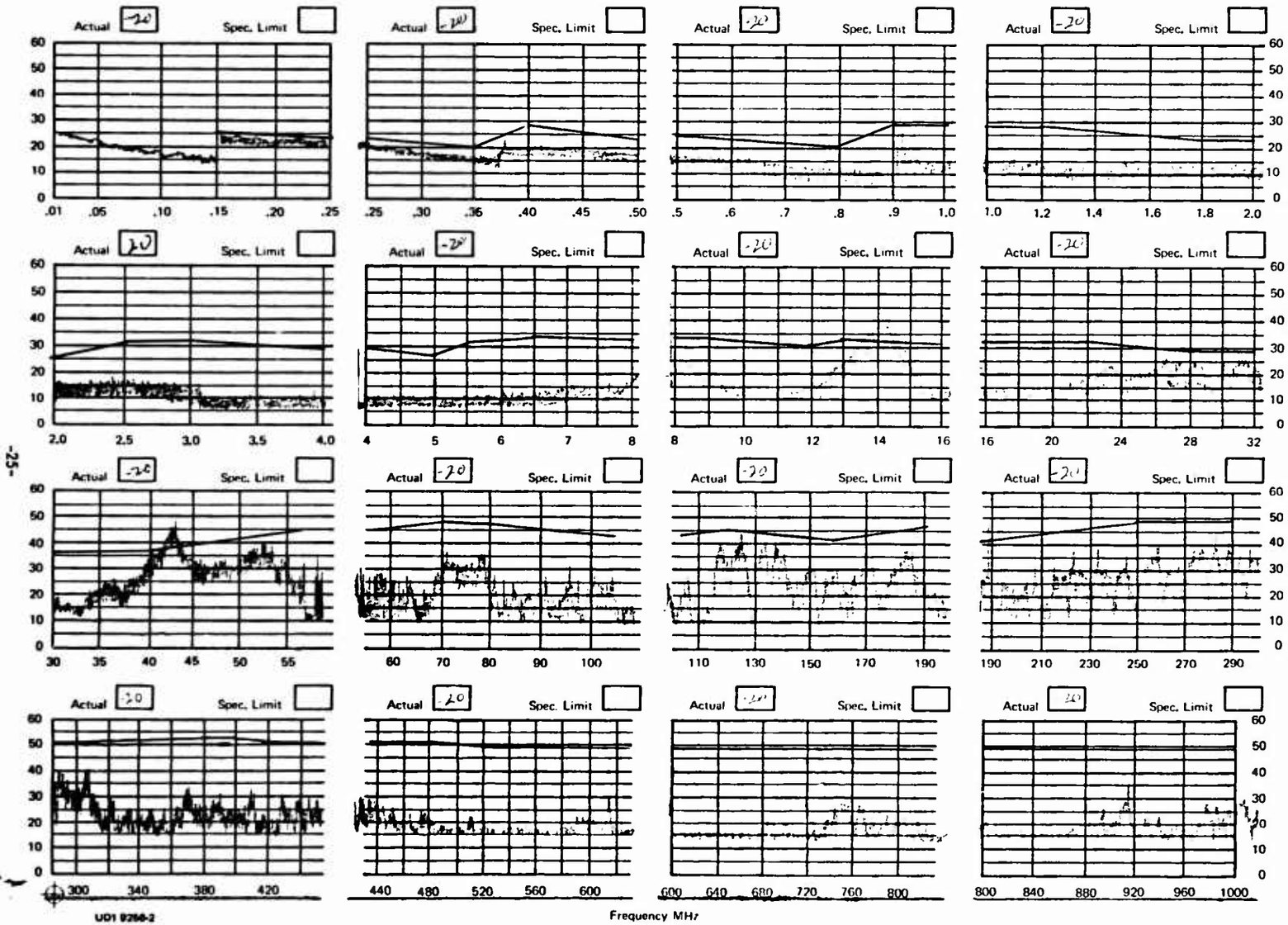
Remarks 45°

Conducted by

Witnessed by

UNIVAC

ATTENUATOR SETTINGS



UDI 9256-2

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Date MAY [illegible] 1977 Page No. 5

A.O. _____

Customer _____

Test Sample _____

Part No. AN/TRN-41

Serial No. 001

Specification MIL-STD-461

Notice _____

Test Method _____

- ☐ Conducted
- ☐ Radiated
- ☐ Broadband
- ☐ Narrowband
- ☐ Transient

Test Mode _____

Test Equipment

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- ☐ Current Probe – PC105 S/N H-301
- ☐ LISN – 7010
- ☐ 10μf–Capacitor
- ☐ Antenna Loop
- ☐ Antenna Rod 41" – ~~96010-1 S/N 109~~
- ☒ Antenna Biconical 94455-1 S/N 47
- ☒ Antenna Conical 93490-1 S/N 109

Bandwidth _____

Scan Speed _____

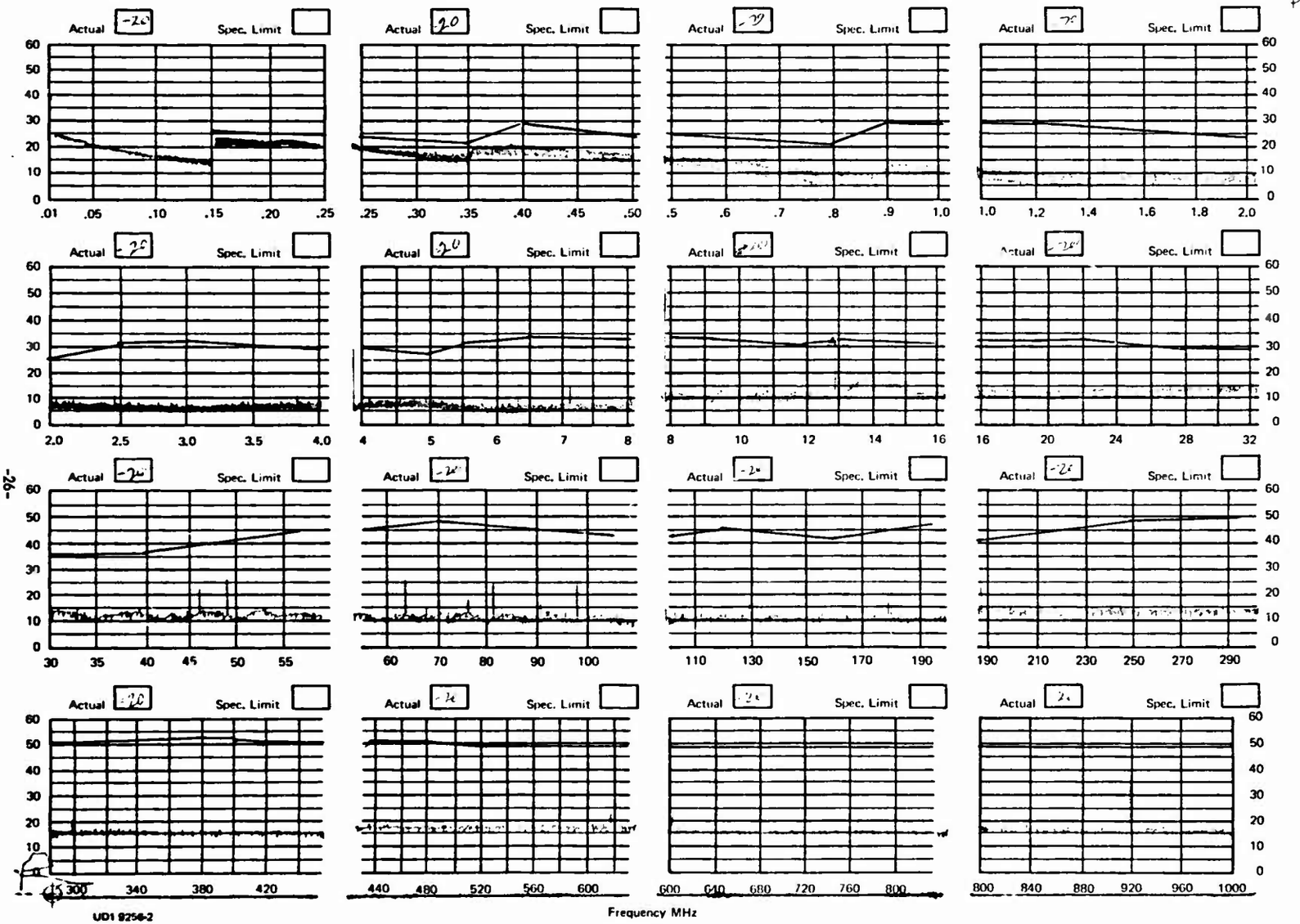
Remarks 1231

Conducted by _____

Witnessed by _____

UNIVAC

ATTENUATOR SETTINGS



UD1 9256-2

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Date MAY [illegible] 1977 Page No. 6

A.O.

Customer

Test Sample

Part No. AN/TRN-41

Serial No. 001

Specification [illegible]

Notice

Test Method

- Conducted
- Radiated
- Broadband
- Narrowband
- Transient

Test Mode

Test Equipment

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- Current Probe – PC105 S/N H-301
- LISN – 7010
- 10μf–Capacitor
- Antenna Loop
- Antenna Rod 41" ~~– 95010-1 S/N 109~~
- Antenna Biconical 94455-1 S/N 47
- Antenna Conical 93490-1 S/N 109

Bandwidth

Scan Speed

Remarks Standby

Conducted by

Witnessed by

UNIVAC
DIVISION OF SPERRY RAND CORPORATION

EMI DATA RECORD

SHEET ___ OF ___ | TEST NO.

TEST SPECIMEN	PROGRAM OR MODE	TESTED BY	DATE
AN/TRN-41	RADIATED EMISSIONS	RA	3/15/77

INSTRUMENTATION	CALIBRATION DUE	PICKUP DEVICE
See Paragraph 6.1		

TEST PARAMETER	NOTES
RS02	Frequency range ~~1-10~~ 1GHz to 10 GHZ

Channel												
65X	2ND	HARMONIC			-90 dBM							
	3RD	HARMONIC			-105 dBM							
123X	2ND	HARMONIC			-70 dBM							
	3RD	HARMONIC			-75 dBM							

A-2078

ATTACHMENT 3

DATA SHEETS FOR RADIATED SUSCEPTIBILITY TESTS

UNIVAC
DIVISION OF SPERRY RAND CORPORATION

EMI DATA RECORD

SHEET 1 OF 2 | TEST NO.

TEST SPECIMEN	PROGRAM OR MODE	TESTED BY	DATE
AN/TRN-41	RADIATED SUSCEPTIABILITY	RD	5/27/77

INSTRUMENTATION	CALIBRATION DUE	PICKUP DEVICE
See Paragraph 6.1		

TEST PARAMETER	NOTES
RS02	Frequency range 14 KHZ to 10 GHZ

Channel 65X		Field Intens- V/Meter	Freq. of Failure	Failure Level V/Meter	PRF	CW					
	14KHz										
	To 65MHz	100V/M	63MHz	75V/M			Josie replies				
	65MHz										
	To 210MHz	100V/M					no failure				
	210MHz										
	To 600MHz	100V/M	360MHz	77V/M			Josie replies				
			560MHz	55V/M			Josie replies				
	600MHz										
	To 1000MHz	100V/M	610MHz	45V/M			Josie replies				
	900MHz										
	To 10GHz	100V/M					no failure				

A-2078

UNIVAC

DIVISION OF SPERRY RAND CORPORATION

EMI DATA RECORD

SHEET 2 OF 2

TEST NO.

TEST SPECIMEN	PROGRAM OR MODE	TESTED BY	DATE
AN/TRN-41	RADIATED SUSCEPTIBILITY	RD	5/27/77

INSTRUMENTATION	CALIBRATION DUE	PICKUP DEVICE
See Paragraph 6.1		

TEST PARAMETER	NOTES
RS02	Frequency range 14 KHZ to 10 GHZ

Channel 123X		Field Intens- V/Meter	Freq. of Failure	Failure Level V/Meter	PRF	CW	
	14 KHz TO 65 MHz	100V/M	63 MHz	70 V/M			lose replies
	65 MHz TO 210 MHz	100V/M					no failures
	210 MHz TO 600 MHz	100V/M	230 MHz	50V/M			lose replies
			570 MHz	50V/M			lose replies
			265 MHz	50V/M			lose replies
			450 MHz	55V/M			lose replies
			340 MHz	55V/M			lose replies
	600 MHz TO 1000 MHz	100V/M					no failures
	900 MHz TO 10 GHz	100V/M					no failures

A-2075

ATTACHMENT 4

PRE-OPERATIONAL TEST DATA SHEET

June 30, 1976

DATA SHEET
OPERATIONAL TESTS
AN/TRN-41

Test EMC Date 3-3-77

System #002 Time

Tech Dave Daniel

Para. No.	Description	Pre Test	Test	Post Test	Requirements	Units
6.1	Calibrated RF insertion loss P_L = 31.3 dB Used in determining RF peak power.	N/A	N/A	N/A	N/A	N/A
6.2	System turn on normal operation	✓			Check if OK	N/A
6.3.1	Antenna radiated signal 15 Hz	✓			Check if OK	N/A
	135 Hz	✓			Check if OK	N/A
6.3.2	Antenna Speed	66.667			66.667 ± .133	ms
6.4.1.1	Correct identity code	✓			Check if OK	N/A
6.4.1.2	Identity period	36.5			37.5 ± 3.75	Seconds
6.4.2	Peak power (1) Reading of peak power meter Pm =	87			N/A	Watts
	(2) Convert to dBm - 10 log Pm x 10^3 = Pm dBm	49.4			N/A	dBm
	Total power output in dBm $P_{mdBm} + P_L$ = *Insertion loss see 6.1 above.	50.7			50 dBm	dB
6.4.3.3	Pulse count	7200			7200 ± 180	Counts
6.4.4.2	Pulse shape Width (50%)	3.42			3.5 ± 0.5	μs
	Rise time (10-90%)	2.07			2 ± 0.25	μs
	Fall time (90-10%)	2.72			2.5 ± 0.5	μs
6.4.4.4	Pulse spacing	12.05			12.0 ± 0.1	μs
6.4.5.2	Delay - 60 ±10 μs 15 Hz trig to first burst pulse.	60 ✓			Check if OK	

DATA SHEET

OPERATIONAL TESTS

AN/TRN-41 (Continued)

Para. No.	Description	Pre Test	Test	Post Test	Requirements	Units
6.4.5.3	Correct north Burst - 12 pulse pairs spaced 30 ± 0.1 μs	30 μsec			Check if OK	
6.4.5.5	Delay 60 ± 10 μs - 135 Hz trig to first burst pulse	✓			Check if OK	
6.4.5.6	Correct Aux burst - 6 pulse pairs spaced 24 ± 0.1 μs	✓			Check if OK	
6.4.6.5	RT replies to 3300 interrogations	2706			≥2310 (Counts/Sec	
6.4.6.7	Demand only mode - times to switch from ON to STBY within 70 seconds	✓			Check if OK	
6.4.6.8	STBY mode	✓			Check if OK	
6.4.6.9	Demand Only mode - time to switch from STBY to ON ≤15 sec	✓			Check if OK	
6.4.6.10	ON AIR mode	✓			Check if OK	
6.4.7.1	DME ONLY mode	✓			Check if OK	
6.4.7.2	Switch from DME to TACAN	✓			Check if OK	
6.4.8.1	Antenna Alarm - Within four seconds	✓			Check if OK	
6.4.8.2	Alarm Reset	✓			Check if OK	
6.4.8.3	RT Alarm - Within five seconds	✓			Check if OK	
6.4.8.4	Alarm Reset	✓			Check if OK	

ATTACHMENT 5

CHANGES TO AN/TRN-41 THAT WERE CONSIDERED TO IMPROVE EMC

CHANGES TO AN/TRN-41 CONSIDERED TO IMPROVE EMC

1. Shielding of the power cable to the system. Shielded cables were used to see the effect on radiated emissions and radiated susceptibility. The radiated emissions were reduced considerably in the range of 6 to 30 MHz. This change also eliminated the RT circuit breaker tripping in the electric fields between 15 and 200 MHz. This change has been incorporated in the system by EC.

2. EMI Filters. Several EMI filters were tested to see what effect they had on emissions and susceptibility. The filters that were small enough to physically be installed in the RT had no effect on the electromagnetic characteristics. The larger EMI filters had about the same effect as shielding the power cables. No changes were made.

3. Proper grounding of antenna. The RF gaskets on the speed control and motor drive assembly were not making proper connection. It was found that the coating on the covers for these assemblies was zinc chromate and good connection was not being made. The zinc chromate was removed where the gaskets made contact and an irridite finish applied. The drawings called out the proper finish but the preproduction units had been finished wrong.

   The antenna grounds were not connected to the RT through the antenna control cable shields. This was caused by the surface on the speed control cover, that the connector was fastened to, being anodized. An EC has been processed to change this finish.

   These changes improved the radiated emissions in the 30 to 300 MHz range.

4. Bandpass Filter. A bandpass filter with upper cutoff at 1400 MHz and lower cutoff at 700 MHz was installed in place of the lowpass filter in the RT output RF line. This filter has some effect on both emissions and susceptibility in the 6 to 200 MHz range. An EC has been submitted to make this change.

5. Reducing noise on motor brush leads. Various combinations of capacitors and shielding leads were tried on the motor brush leads and motor drive assembly to reduce noise. A .47 uf capacitor between the positive and negative motor brush blocks and two shielding leads on each lead, to the brushes, in the motor drive assembly cavity seemed to reduce noise better than other combinations tried. These changes have been made by EC.